METHOD AND APPARATUS FOR TRI-COLOR RAIL SIGNAL SYSTEM WITH CONTROL

BACKGROUND

The present application relates to the field of signaling devices. Although described with particular application to LED rail and traffic signaling applications, it is to be appreciated that the present application is applicable to other types of signaling devices and operations including, but not limited to, transit, pedestrian, automobile, truck, and marine signaling devices. Those skilled in the art will appreciate applicability of the present application to the applications where it is desirable to reduce the effect of external light loading on signaling devices.

Traditionally, traffic lights have used light bulbs in order to produce light. A colored filter was installed in front of each bulb for producing one of the three traffic lights common colors. However, traffic lights using this technology have some drawbacks. One, the bulbs power consumption is high (each being between 100 W and 160 W), increasing the operation costs. Another problem is the short lifetime of the bulb which decreases with environmental conditions such as vibration and temperature.

LED signal modules are rapidly becoming the world standard for replacing conventional incandescent signal lamps. In recent years, their high-energy efficiency and super-long lives have helped colored LEDs make inroads into applications such as traffic signals and exit signs, interior auto lights and outdoor signs. LED traffic signals offer many benefits that can reduce overall operating and maintenance costs. Reportedly, thirty five to forty percent of traffic signals in North America have been converted to LEDs as municipalities seek to reduce maintenance and energy costs. Some LEDs might last as long as five years in traffic signals and result in energy savings of up to as much as ninety percent.

However, there are certain problems associated with the use of LEDs for signal applications. For example, when the sun or another source of an oncoming light strikes the LED signal head, light enters the system and reflects back out providing a false white signal indication or a washed out indication of other colors. As a result, users do not recognize the traffic signals correctly.

Several solutions have been offered to solve this problem, none of which has produced adequate results. Louvers and sun shields do not help with the oncoming light sources. Another solution is to tin the LEDs. This causes false white positives when the oncoming light strikes the signal head. Polarizing filters have proved to be of little help, since the light entering the system does not show significant polarization. The present application contemplates a new and improved method and apparatus that overcomes the above-referenced problems and others.

BRIEF DESCRIPTION

In accordance with one aspect of the present application, a signaling control device apparatus is disclosed. The signaling control device comprises a light source, comprising at least one LED and having a light emitting surface. At least one sensor is set to detect an external light load directed to the light emitting surface and generate a control signal indicative of a presence of the light load.

In accordance with another aspect of the present application, a method of controlling a signaling device is disclosed. A light source comprising a plurality of LEDs and having a light emitting surface is provided. At least one sensor is set to detect an external light load directed to the light emitting surface. In response to detecting a presence of the light load, the at least one sensor generates a control signal indicative of detecting the light load.

One advantage of the system is driving LEDs at the higher current only when the light load is present to overcome the false signal indication and contrast reduction issues.

Another advantage of the system is quick and inexpensive solution to overcome the false signal indication and contrast reduction issues.

Still further advantages and benefits of the present application will become apparent to those of ordinary skill in the art upon reading and understanding the following detailed description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a view of a conventional traffic signal;

FIGURE 2 is a view of a solid state signal light;

FIGURE 3 is a flowchart of a method of supplying a higher current to the LEDs while the light load is present; and

FIGURE 4 is a flowchart of a method of supplying a higher current to the LEDs taking into consideration a magnitude of the light load.

DETAILED DESCRIPTION

With reference to FIGURE 1, a conventional traffic signaling device **10** such as the ever-present three-color (red, yellow, green) traffic control signal is schematically shown. The signaling device **10** is suitable for providing the red, yellow, or green light of a three-color traffic signal, and includes solid state light **12**, which emits light when driven by an electrical current. Light produced by the light **12** is collected by signaling device optics (not shown) that may include a reflector, which is typically a parabolic reflector, and a lens to produce a light beam outwardly directed from the signaling device **10** with a suitable beam spread. The beam spread should be narrow enough to direct the light toward roadway users with a high degree of efficiency, but wide enough so that roadway users including pedestrians at the periphery of the road and drivers a substantial distance from the intersection can readily see the signal.

The signaling device **10** might include a cover to protect light **12** from dirt and dust. The cover may optionally include additional elements such as a visor or a tinted filter for spectrally filtering the light to produce a red, green, or yellow output. For traffic signal devices providing a shaped light such as a left turn arrow, an "X" lane marker indicating "wrong way", a pedestrian "walk" or "don't walk" signal, or the like, a masking filter is typically included with the cover to define the selected shape.

The signaling device **10** includes an electrical control circuit **14**, which preferably includes an electric power conditioning electronics. As it is known to those skilled in the art, incandescent traffic lights are typically powered by the AC electrical voltage sources in the range of about 80-135 volts (for the nominally 120VAC standard) or about 185-275 volts (for the nominally 220VAC standard), and typically draw hundreds of milliamperes of current. In one embodiment, the solid state light **12** includes a plurality of LEDs each operating at a few volts DC and drawing a few tens of milliamperes of current. The electrical control circuit **14** receives electrical power from the AC power source and conditions the electrical power to operate the solid state light **12**.

In one embodiment, the conditioning electronics includes a switching power supply (not shown) for converting the AC line voltage to a DC rectified current adapted for powering the solid state light **12**. Preferably, the switching power supply has a high power factor and low current harmonic distortion. Advantageously, the switching power supply has a low power loss and, preferably, includes the capability of controlling the output current to optimally drive the light **12**.

With further reference to FIGURE 1, a source of an external light load **16** such as sun or any other source of an oncoming illumination enters the system striking a light emitting face **18**. The light reflects back providing a false white signal or a washed out indication of other colors.

With reference to FIGURE 2, light emitting diodes **20** (LEDs) are mounted on an interface board such as a printed circuit board **22**. In one embodiment, the LEDs **20** are white light-emitting LEDs such as white light-emitting phosphor-coated ultraviolet GaN LEDs. The use of white light-emitting LEDs makes the light **12** a spectrally close retro-fit for the conventional incandescent light bulb used in the signaling devices that typically emits white light. Such retro-fit light **12** employing white light-emitting LEDs, is preferably used for retro-fitting any of the red, yellow, or green balls of the conventional three-color traffic light.

In another embodiment, the LEDs **20** include colored LEDs which produce light predominantly in the selected filter pass-band. Thus, red LEDs are advantageously employed for retro-fitting a red traffic light ball, yellow LEDs are employed for retro-fitting a yellow traffic light ball, and green LEDs are employed for retro-fitting a green traffic light ball. Preferably, the suitable colored LEDs include AlGaInP-based LEDs and GaN-based LEDs with or without phosphor coatings. Of course, it is also contemplated that other LEDs with suitable optical characteristics might be used. Preferably, when the colored LEDs are used, a multiple-layer dielectric stack mirror is employed, which is tuned to have a high reflectivity over a selected spectral range which coincides with the colored LED light output.

With further reference to FIGURE 2, a sensing device **24** such as a photodiode is located on the same printed circuit board as LEDs **20**. Preferably, the sensing device **24** is protected from the light emitted by the LEDs **20** by a baffle. Alternatively, the sensing device **24** is located in a remote enclosure. The advantage

of the remote location is the better means for orienting and aligning the sensing device **24** towards the source of the oncoming illumination **16**. It is particularly useful if the signaling device **10** is positioned on sharp bends or transit.

With reference to FIGURE 3, in a step **30** the sensing device **24** is detecting if any source of the oncoming illumination **16** is shining towards the light emitting surface **18**. If the oncoming illumination is detected by the sensing device **24**, in a step **32**, a control signal is generated. The control signal is received by an electrical control system **14**, which, in a step **34**, generates and supplies a higher current to the LEDs **20**, preferably while the light load **16** is present.

With reference to FIGURE 4, in a step **36** the sensing device **24** detects a magnitude of the light load **16**. In the step **32**, the sensing device **24** generates the control signal indicative of a value of the magnitude. The signal is received by an electrical control system **14**. In the step **34**, the control system generates the higher current in proportion to the magnitude of the light load **16** and supplies it to the LEDs **20**. In one embodiment, the control system **16** is a close loop feedback control system, adjusting the current in proportion to the magnitude of the light load **16** on the fly.

Preferably, in the step **34**, the control system **16** generates a continuous higher current. Alternatively, the increased current is supplied as a pulse, causing a blinking effect. The blinking current goes from a standard operating state to a raised state in intensity and then back down again, not perceived as blinking off, but blinking brighter. In yet another embodiment, the current is raised in a modified fashion to appear constantly on, but at a higher intensity, by pulsing the current at a frequency higher than visually perceivable.

The exemplary embodiment has been described with reference to the illustrated embodiments. Modifications and alterations will occur to others upon a reading and understanding of the preceding detailed description. It is intended that the exemplary embodiment be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.